UNITED STATES MARINE CORPS

LESSON PLAN

ATMOSPHERIC THICKNESS

INTRODUCTION:

1. Gain Attention. A properly analyzed thickness chart will show areas of significant temperature advection. An analyzed thickness chart provides significant information about the vertical motion and weather likely to occur at any location on the chart.

2. Overview. In this period of instruction, you will learn how to analyze a thickness chart. Analysis is more than just coloring charts. While you are drawing lines and shading areas of the chart, you should be thinking about the dynamic processes in the atmosphere, which are occurring.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. With the aid of references, Given a SFC/1000-500-mb thickness chart, analyze the chart correctly as determined by a master solution.

b. Enabling Learning Objective(s). Without the aid of references, analyze a SFC/1000-500mb thickness chart correctly and explain what is happening in the atmosphere.

4. Method/Media. This period of instruction will be taught using the lecture method with aid of QMMCBT-001 "Introduction to the Dynamics of the Atmosphere".

5. Evaluation. The student shall not be evaluated, however, there will be a question and answer period at the conclusion of this period of instruction.

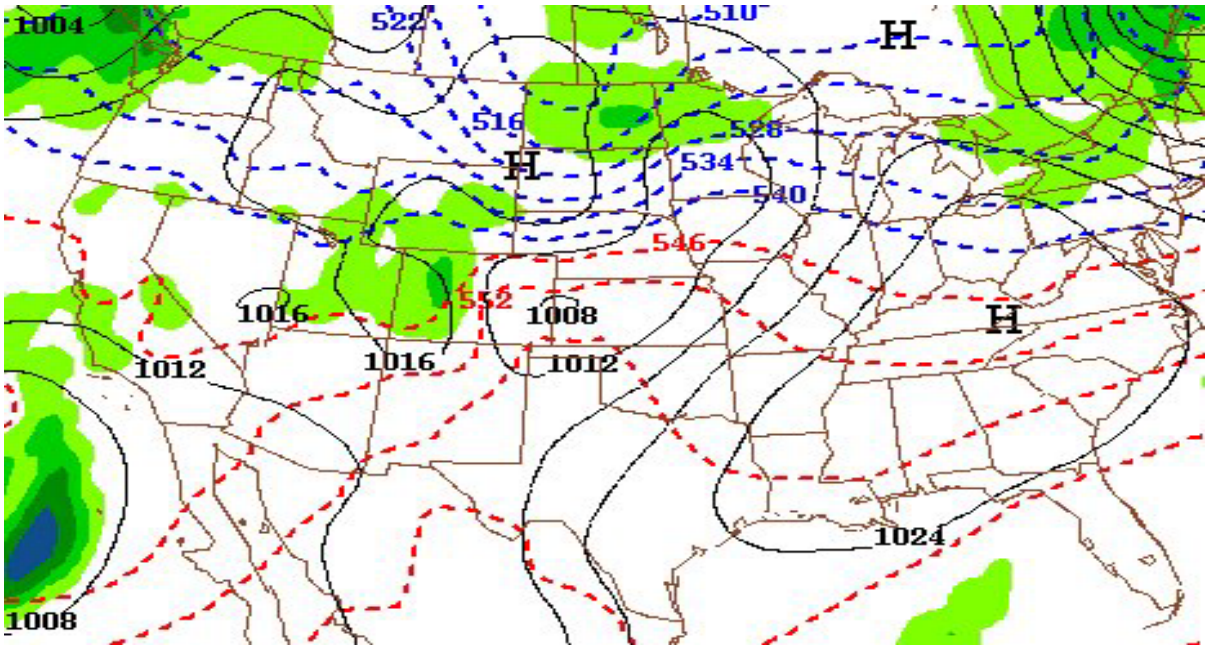
TRANSITION. Are their any questions on the TLO, ELO's, the methods of media, and evaluation at this time?

BODY:

1. Identify different characteristics found on a Thickness Chart.

a. Thickness usually refers to the depth of the 1000-500 hPa layer in the atmosphere. However charts are also produced for the thickness of other layers in the atmosphere as well. The thickness gives an indication of the mean temperature within a layer; lower thickness values indicate colder air, higher thickness values warmer air.

b. Forecast Mean Sea Level charts will also often show the 1000-500 hPa thickness as dashed lines. The thickness on these charts is usually given in decameters. So the 540-line indicates the 1000-500 hPa layer is 5400 meters deep.



c. Thickness charts in general and the 1000-500 hPa thickness charts in particular are also very useful for determining baroclinic zones and development. Thickness lines can also indicate the steering direction of surface highs and lows.

d. You can find out where Cold/Warm air advection on these charts which will make placing your fronts much more accurate.

2. Latitudinal Differences. Latitudinal Differences of the atmosphere is explained very easily. Your temperature contrast is lower near the pole which is directly proportional to the thickness in cold regions. Near the Equator your temperatures are higher thus making your thickness higher in the hotter regions.

3. Hypsometric Equation. When the ideal gas law and the hydrostatic equation are combined, we can derive an equation that allows us to calculate how pressure varies with height in an atmosphere with an arbitrary temperature profile. This equation is called the hypsometric equation:

$$\Delta z = z_2 - z_1 \approx \frac{R_d}{|g|} \cdot \overline{T_v} \cdot \ln\left(\frac{P_1}{P_2}\right)$$

a. The hypsometric equation tells us that the thickness between two pressure levels is directly proportional to the average temperature within the layer. We can use thickness as a measure of the average temperature of a layer. We use contours of thickness in a similar manner to how we use isotherms. Remember that colder layers are thinner and warmer layers are thicker.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. At this time are there any question pertaining to the subject material that has been presented to you?

2. Questions to the Class. There are no questions for the class at this time.

SUMMARY: Through this period of instruction the student has learned that thickness charts and understanding how to read them is a very helpful tool in locating and also determining the movement of different weather phenomena. In turn, making the student able to forecast much more accurately.

REFERENCE.

Ahrens, Donald C. Meteorology Today. 4th Edition. West Publishing Company, 1991.

Atmospheric Thermodynamics. http://snowball.millersville.edu/